Supporting Deaf and Hard of Hearing Undergraduate Students in STEM Field Settings with Remote Speech-to-Text Services
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Challenge
When deaf and hard-of-hearing students attend field trips, they are often at a disadvantage. If students are using an interpreter, the interpreter may be at risk due to the terrain of the field visit, or weather conditions. If students normally receive speech-to-text support in the classroom, current technology cannot support the service in the field. This project seeks to address these problems by providing an alternative speech-to-text support that will enhance STEM learning.

Objective
To develop a remote speech-to-text assistive technology (remote C-Print) that will allow individuals who are deaf and hard of hearing, including those with low vision, to view real-time transcription in remote, non-traditional settings (for example, field trips) using a handheld device such as a Smartphone.

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**Student Ratings of Benefit of Smartphone on Field Trips**

Use of display and ease of use of C-Print on smartphone:
- Students reported that on average, they spent about half the time looking at the display (1=never, 5=all of the time), (M=3.25, SD=7.5).
- Students also reported that it was relatively easy to read C-Print text on the smartphone display (0=did not use, 1=very difficult, 5=very easy) (M=4.50, SD=6.74).

Comprehension of the C-Print display on the smartphone:
- Students rated their understanding of the teacher or presenter during the trip on a likert-type scale, 0=0-20% comprehension, 6=90-100% comprehension. The average comprehension score for all trips was 4.00 (SD=1.71), or 70-80%.
- As the technology improved, so did mean comprehension of the presenter. For trips 1 and 2 the average rating was 2.3, or 40-50%; for trips 3 through 9 the average rating was 5.07, or 80-90%.

**Interview Results**

**Student comments**
Regarding helpfulness in learning material:
- Allows me more ‘freedom’. I don’t always have to rush up to the front to make sure I don’t miss information. It also lets me go back and read information during the trip (disadvantage of an interpreter). If the information is accurate and is delivered promptly, this makes the field trip easier to follow.
- Going on a field trip was much more interactive and engaging than sitting in a classroom. When one is sitting in a classroom with eyes glued to a laptop screen, it takes away much of the interactivity going on in the classroom. On the field trip, I was looking around a lot back and forth with the phone and it was a lot more simulating.

**Overall reaction to project:**
- …I think it’s a very promising project and definitely feasible and preferable to a non-native signer once the kinks are smoothed out.

**Faculty comments**
Perceived benefits for students:
- And speaking of loud, I will just add this. That because some of the areas were loud, many of the hearing students were envious that the deaf student could understand what was going on, when they themselves could not.
- It sounded like a really interesting idea it seemed to make a lot of sense and it just seemed like a great way to add a little value for the field trip for the deaf and hard of hearing students. And I think that it could probably benefit the hearing students as well in some cases because it is not always easy to hear what someone is saying in some of those environments.

**Overall reaction to project:**
- So it would seem that just the utility of this is so much more effective than sending someone out with all of this equipment and tables and laptop stands and power supplies and everything. …I think it has so much potential in a wonderful way.

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**Field Trip Trials**

<table>
<thead>
<tr>
<th>Course</th>
<th>Destination</th>
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<tbody>
<tr>
<td>Advanced Biomedical Photography</td>
<td>George Eastman House, Intl.</td>
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<tr>
<td>Data Analysis</td>
<td>Museum of Photography &amp; Film</td>
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<tr>
<td>Distribution Systems</td>
<td>Casa Larga Winery</td>
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<td>Environmental Health &amp; Safety Management</td>
<td>Eastman Kodak Company</td>
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<td>GIS Applications UCS</td>
<td>High Falls Brewery</td>
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<tr>
<td>Manufacturing Process</td>
<td>Monroe County Water Authority</td>
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<tr>
<td>Packaging Distribution</td>
<td>Monroe County Office Building</td>
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<tr>
<td>WAN/LAN Planning &amp; Design</td>
<td>P &amp; R Industries</td>
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**Sample of Text from Field Trip** (Frontier Telephone & PAETEC)

We have nozzles we pump air through to keep a constant flow of air. If there is a breach or hole in the cable or corrosion, the air will keep the water from coming in. We also have jelly filled cables which serve the same purpose, taking up extra space in the cable so no water can permeate.

Along the walls you see smaller ones, orange and black. Those are fiber cables. There are 800-1200 pairs per cable, copper cable pair. The fiber ones hold 645,300 pairs, so you can see the advantage of those.

Now we will go over where the air compressors are. There are flow meters that we check daily. We keep daily measurements. If a cable is flowing at certain level for 30 days and it jumps suddenly, that tells us there was a breach. We will send a cable crew to see why there was such a drastic increase in flow.

Let’s move on. Everyone in? I will try to speak up it is noisy in here. These are air dryers. They remove the moisture from the air and pressurize the cable. They are high tech air compressors.

These are flow meters. There are little heads to measure how much is going through the cables. Everything is redundant in here. We have primary and backups. Everything in the phone environment is redundant. If one system goes down we have a backup to take its place. Switching, air dryers, you name it, a lot of it is redundant.

Behind me there are some nitrogen tanks. We hook them up to the nozzles and use those until we can supply air and get one of the dryers back up and running.

**Any questions?**

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**Remote captioning process.**

**Smartphones receive and display text in real time.**

**Student views text of instructor’s lecture on a Smartphone.**

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